EP 300792 (7)

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61B 5/107, G01N 33/12, G01G 19/50 — A1

(11) International Publication Number: **WO 00/28897**

(43) International Publication Date: 25 May 2000 (25.05.00)

(21) International Application Number: PCT/GB99/03775

(22) International Filing Date: 12 November 1999 (12.11.99)

(30) Priority Data:
9824976.6 13 November 1998 (13.11.98) GB
9900296.6 7 January 1999 (07.01.99) GB

(71) Applicant *(for all designated States except US)*: MARS U.K. LIMITED [GB/GB]; 30 Dundee Road, Slough, Berkshire SL1 4LW (GB).

(72) Inventors; and

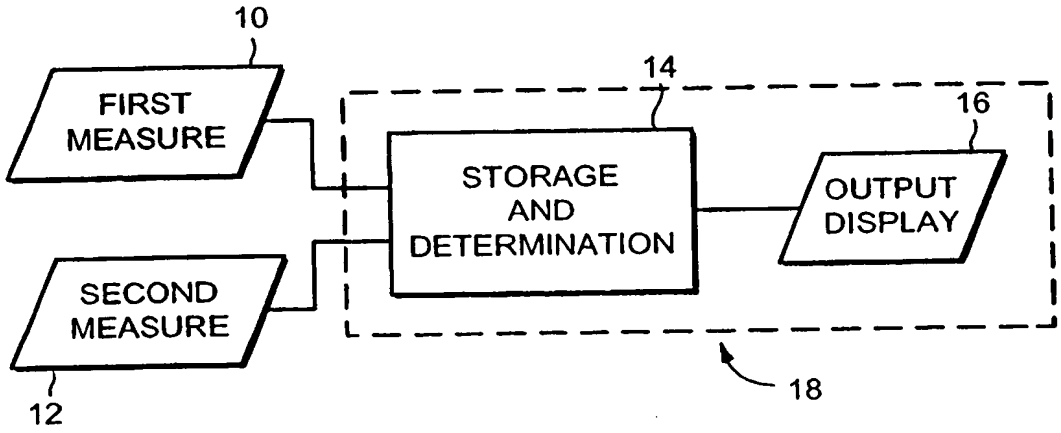
(75) Inventors/Applicants *(for US only)*: HAWTHORNE, Amanda, Jane [GB/GB]; 1 Langar Cottages, Main Street, Langar, Nottingham NG13 9PA (GB). BRADLEY, Richard [GB/GB]; 4 Mill Lane, Croxton Kerral, Grantham, Lincolnshire NG32 1RA (GB). BUTTERWICK, Richard, Fulton [–/GB]; 6 Mona Road, West Bridgford, Nottingham NG2 5BQ (GB).

(74) Agent: LOVELESS, Ian, Mark; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BODY FAT MEASUREMENT SYSTEM



(57) Abstract

A body fat measurement system for mammals includes means for measuring first and second body dimensions having a high correlation with body fat and low correlation respectively. A lookup table provides an output of the percentage body fat on input of the first and second dimensions.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

BNSDOCID: <WO_____0028897A1_I_>

BODY FAT MEASUREMENT SYSTEM

The present invention relates to a system for measurement of the percentage of body fat by weight of four legged mammals, in particular four legged domestic pet mammals such as domestic cats.

Obesity is the most common form of malnutrition in cats, however, the links between obesity and the risk of clinical conditions are not well understood. This is primarily because there is no accepted method for defining obesity or measuring body fat in cats.

The body mass index (BMI), which is based only upon measurements of body weight and height, allows objective measurement available for humans. The main techniques available to veterinary practitioners are subjective ones such as the Body Condition Score (BCS) system produced by Laflamme.

We have appreciated the requirement for a simple, objective system for determining the percentage body fat by weight of four legged domestic pet mammals, in particular cats. In particular, we have appreciated that the system should be reliable and capable of implementation in both technologically simple and complex embodiments. The system should also be easy for inexperienced operators to use.

Accordingly, there is provided a four legged domestic pet mammal body fat determining system for determining the percentage body fat of a four legged domestic pet mammal, comprising:

- means for measuring a first body dimension having a high correlation with percentage body fat;

- means for measuring a second body dimension having a low correlation with percentage body fat; and
- a look-up table comprising a first storage area for storing entries of the first body dimension, a second storage area for storing entries of the second body dimension and an output area for indicating the percentage body fat determined from a relationship between the first and second body measurements.

The system of the invention has the advantages of being simple to operate, reliable and capable of implementation as a low technological manual system, or a more sophisticated computerised implementation.

In a preferred embodiment the first body dimension is the circumference of the ribcage. This measurement has been appreciated, through experimentation, to be highly correlated to a four legged mammal's percentage body fat. In the embodiment, the second body dimension is a leg index measurement, preferably the distance between the Patella (knee) and the calcaneal tuber (hock) with the leg flexed of the hind limb which, we have appreciated, has a low correlation with percentage body fat. The use of the body measurement of high correlation with body fat and one with low correlation increases the accuracy of the determined percentage body fat.

We have also appreciated the difficulties in providing a correct energy allowance for four legged domestic pet mammals such as cats.

Feeding guides for cats are based on an understanding of their daily energy requirement. A precise understanding of the energy requirement of the cat is therefore fundamental for the development of accurate feeding guides. If the predicted energy requirement of a cat is lower than the actual energy needs then the feeding guide

BNSDOCID: <WO_____0028897A1_I_>

will not provide sufficient energy. On the other hand if the estimated energy requirement for a cat overestimates the actual energy needs then the feeding guide will provide too much energy which can potentially cause the animal to become overweight.

We have also appreciated that a system for measuring percentage body fat can be used to provide a system for determining the energy requirement and ideal weight of a four legged mammal, such as a cat.

Accordingly, there is also provided a four legged domestic pet mammal target body weight determining system for determining a target body weight for a four legged mammal, comprising: a system for measuring the percentage body fat of a four legged domestic pet mammal; and a lookup table comprising a first storage area for storing entries of the percentage body fat, a second storage area for storing entries of body weight, and an output storage area storing an indication of the target body weight. The preferred embodiment also comprises a system for determining the energy requirement based on the ideal weight.

A system embodying the invention will now be described with reference to the accompanying figures in which:-

Figure 1 - is a diagrammatic representation of a system embodying the invention;

Figure 2 - is a diagrammatic representation of a first look-up table for use in the system of Figure 1;

Figure 3 - is a diagrammatic representation of a second look-up table for use in the system of Figure 1;

Figure 4 - is a diagrammatic representation of a third look-up table;

Figure 5 - is a diagrammatic representation of a fourth look-up table;

Figure 6 - is a diagrammatic representation of a fifth look-up table; and

Figure 7 - is a diagrammatic representation of a sixth look-up table.

The embodiment shown in Figure 1 may be either manually operated, or a computerised system. A first measurement device 10 and a second measurement device 12 are provided to take measurements of, respectively, the ribcage circumference and the leg index measurement [LIM] to provide the results to the look-up table 18. In a computerised embodiment, the measurement devices 10, 12 would provide measurement signals to a computer, storing therein in first, second and output storage areas respectively, ribcage and LIM, and corresponding fat percentage indications. These are shown as storage and determination functions 14 in Figure 1. The results are displayed as an output display 18. The determination algorithm (described later) could be coded in any simple computer language, and is within the common general knowledge of the skilled person, and need not be described here.

A manual representation of the look-up table 18 is shown in Figures 2 and 3. There is shown a first storage area 20, storing first body dimensions (ribcage) measurements, and a second storage area 22, storing second body dimensions (LIM). An output storage area 24 stores an

BNSDOCID: <WO_____0028897A1_I_>

indication of the percentage body fat of a domestic cat as a relationship of the first and second dimensions. The indication is under, normal or overweight in Figure 2. In figure 3, the indication is given as a percentage number.

In appreciating that the system embodying the invention provides a uniquely robust and reliable system for determining the percentage body fat of a cat, a number of experiments were undertaken, as will now be described.

To establish the correlation between body condition score (BCS) and body composition (% body fat) as measured using Dual Energy X-Ray Absorptiometry (DXA), and to compare zoometric measurements with estimates of body condition score and % body fat using DXA, in order to develop a simple objective method of determining body condition, the following method was adopted.

Zoometric measurements and estimates of BCS (body condition score) and body composition (using DXA), were take from 60 domestic, short-haired cats, housed indoors. All measurements were taken between 03/03/97 and 22/05/97, by a single observer. In the study, 28 males (all neutered) and 32 females (of which 8 were entire) were used. The average age of the females was 4.92 years and males 3.94 years. The body weights of entire female cats ranged from 2.34 to 4.1 Kg, the neutered female cats from 2.84 to 6.6 Kg and the males 4.2 to 8.18 Kg. Cats had been fed a variety of diets at the time measurements were taken.

The following zoometric measurements were taken from each cat. These were selected because they were considered to represent body condition or had been found from human data to be potentially.useful.

Height:	The distance between the ground and the Withers (the top of the shoulder blade or scapula) as measured using a measuring stick. This is a wooden metre ruler with a fixed base, perpendicular to the rule and a sliding wooden bar.
Chest Dept:	The vertical distance from the top of the capula to the bottom of the chest, using a measuring stick.
Girth:	The circumference at the point of the 4th lumbar vertebrae, just behind the last rib, using a measuring tape.
Ribcage:	The circumference at the point of the 9th rib (5 ribs from the posterior end of the ribcage), using a tape measure.
Length:	The horizontal distance from the breast-bone (manubrium) to the thigh perineum), using a measuring stick.
Elbow:	Measured on the left elbow using a calliper. It is the distance between the lateral epicondyle of the humerus and the medial epicondyle of the humerus.
Front Long Bone:	The length of the humerus, from the proximal ulnar epiphysis to the distal radial epiphysis, using a measuring stick.
Leg index measurement [LIM]:	The distance between the Patella (knee) and the calcaneal tuber (hock) with the leg flexed.

All measurements were taken from the left hand side of the cat whilst it was standing with its legs perpendicular to the ground and with its head up and looking forward. Cats were weighed prior to taking the measurements, which were taken in a fasted state. Five replicates of each measurement were taken on the same day.

The Purina Body Condition Score (Laflamme, 1998) was used as a subjective assessment of body condition. The cat was given a score on a nine point scale, which ranged from 1 for emaciated to 9 for morbidly/grossly obese, although experienced assessors are able to grade cats to 0.5 of a scale. A cat with a BCS score of 5 was considered to be ideal. This scoring system was based on a variety of features, which included palpability of the ribs, presence of a discernible waist and abdominal tuck, and evidence of bony prominence and fat deposits on the lumbar area and base of the tail.

The percentage body fat was measured by dual energy X-ray absorptiometry, using a Hologic QDR 1000/W densitometer. They were anaesthetised using Domitor (0.1ml/Kg) and recovery induced with Antisepen.

Eight inexperienced observers each made an estimate of BCS and took their replicates of each zoometric measurement on the same seven cats, in order to test for inter-observer variability in predicting body condition.

Each Zoometric measurement was compared with % body fat because this represented the most objective estimate of body composition. The most significant correlation with % body fat was for ribcage. This factor is more likely to be affected by an increase in body weight or obesity. It may therefore be considered to provide an estimate of % body fat, or 'fatness'. The lowest correlation's with % body fat were found for the LIM and height measurements

(r^2< 15.4%). This is a low correlation. These may therefore be considered to be measurements of stature which are relatively unaffected by changes in % body fat.

We appreciated that a system could be devised using this data to provide a simple system for measuring the percentage body fat of cats. The formula that describes the most variation in percentage body fat and is biologically meaningful is:

$$Fat = [\frac{(\frac{Ribcage}{0.7067} - LIM)}{0.9156}] - LIM$$

The mean, standard deviation and coefficient of variation were determined for each of the 60 cats from the five replicates made for each zoometric measurement by the experienced observer. The mean and median coefficient of variation (CV) for each zoometric measurement was less than 10% suggesting that the intra-observer repeatability was low and that a single measurement would be needed in future (see table below).

CV for each zoometric measurement made by a single experienced assessor.

	Coefficient Of Variation (%)			
	Mean	Median	Min	Max
Weight	2.30	1.19	0	12.78
Girth	1.96	1.57	0.27	6.74
Ribcage	3.03	2.6	0.5	15.57
Height	1.49	0.93	0.18	8.94
Chest Dept	3.54	3.34	1.36	9.62
Length	2.37	2.15	0.22	6.26
Elbow	4.28	4.35	0	9.56
Front Long Bone	2.11	1.77	0	5.26
LIM	2.5	2.16	0.33	8.19

The cats included in this study encompassed a wide range of body composition and age, but were of a single population of related genetic domestic short-haired stock. They may therefore form a representative sub-sample of the domestic cat population in general.

BCS was significantly correlated with % body fat, when measured using DXA (r^2 = 73.4%, $p < 0.01$) and gave a reasonable prediction of % fat. However, the correlation was lower than that reported by Laflamme (1998) where r^2 = 83.5%, although 48 cats were used in this study, of which only 4 individuals had a BCS less than 5. Using the BCS system in this study, cats which were of ideal body condition (BCS = 5) had between 15 and 30% body fat. Cats which were considered to be underweight (BCS < 5), were less than 20% fat and those which were overweight (BCS> 6) were more than 30% fat. Whilst these data sets are relatively small (underweight group = 7 cats, ideal = 8 cats) it gives an indication of the cut off points that might be used for these major categories of % body fat for cats. The largest discrepancy between % body fat and BCS occurred for those animals considered to have a BCS between 5 and 6. This may indicate the problems of correctly identifying animals of 'ideal' condition when animals differed greatly in stature. Animal stature, particularly of very large or small cats was considered to be a determining factor in the large variation of BCS assigned to individual cats by different observers, resulting in a relatively high CV of 15.3%. It would appear that the BCS type of assessment is truly subjective.

By comparison zoometric measurements, and ribcage in particular (r^2 = 82.9%) were more highly correlated with % body fat than the BCS system. This is a high correlation.

The high level of repeatability for the ribcage and LIM measurements of cats and the high correlation between the zoometric model and % body fat suggests that this objective measurement is a more appropriate tool for determining body composition of cats than BCS. In addition it is also non-invasive, requires little training to achieve an acceptable level of repeatability and requires only a metric tape measure. This makes this method available for all veterinary practitioners and cat owners.

Feeding guides for cats are currently formulated on the basis that daily energy requirements are a function of body weight i.e. energy requirement (kcal/day)=70xBW (kg). Different levels of activity (for a given body weight) can be accounted for by using a sliding scale i.e. energy requirement of inactive cats (kcal/d)=50xBW(kg), whilst energy requirement of active cats (kcal/d)=70xBW(kg).

Whilst the effect of different activity levels on energy requirement (and consequently feeding guides) can be accounted for (as above), other factors that influence energy requirements cannot be so easily accounted for using existing methods. In particular body composition or the proportion of fat and fat free mass (or lean tissue) are important factors influencing an individuals energy requirement. Fat free tissue (or lean tissue) is metabolically active whilst fat tissue is not. Energy requirements are therefore determined by the mass of metabolically active tissue (represented by fat free or lean tissue mass) and not by the amount of fat tissue.

Current methods for estimating energy requirements assume that the energy requirement is fixed at a given body weight. However this approach can overestimate energy requirements in certain individuals. For example, in overweight cats lean tissue (or fat free tissue) accounts

for a lower proportion of body weight than in cats of normal body weight. Consequently the energy requirement per unit body weight of overweight cats will be less than that of normal weight cats. As lean tissue is metabolically active and fat tissue is not, cats which are overweight are likely to be offered excessive energy if fed at an energy requirement which is fixed at a given body weight.

This risk of over feeding obese cats was highlighted in a recent study which showed that the mean daily energy requirement of eight obese adult cats (47.74 $\pm$ 2.41% fat) was significantly ($P<0.05$) lower than a group of non-obese (26.05 $\pm$ 1.61% fat) age and sex matched cats, when compared on a kg body weight basis (33 $\pm$ 2 kcal/kg BW and 43 $\pm$ 2 kcal/kg BW respectively). However, when this energy requirement is expressed on a lean mass basis (the proportion of body composition which is considered to be metabolically active) there is no difference between the two groups (67$\pm$2 and 60$\pm$2 kcal/kg lean mass respectively, $P>0.05$).

Feeding the obese cats at a fixed energy requirement for a given body weight would therefore result in an excessive energy allowance and could result in increasing fatness.

Fat free mass (FFM) consists predominantly of lean mass (approx. 97%) and a small amount of bone mineral content. Therefore, expressing energy requirement on a FFM basis will give more accurate feeding guides because it removes the influence of fat mass. Fat free mass can be determined from the weight of the cat and the percentage body fat content of the animal which can be obtained from the feline body mass index (FBMI) (equation 1).

Equation 1 FFM = Body weight(kg)x([100-% Body fat]/100)

The % Body fat could be determined from the Feline Body Mass Index discussed above, or by another method.

The FFM can be converted to an "ideal" body weight (equation 2) which determines the mass of the cat with an optimal body composition (Table 1). Data collected at WCPN showed that cats with an optimal body condition had a body fat content of approximately 25%.

Equation 2 "Ideal" weight = FFMx1.33

The "ideal" weight is the weight at which a cat is neither under or over weight, and can be used as a target weight.

There was no significant difference between the obese and non-obese cats in their energy requirement per kg "ideal" weight (48 ± 2 and 44 ± 2 kcal/kg "ideal" weight respectively), demonstrating that feeding guides based upon "ideal" weight could be more useful than the current ones based upon body weight alone, because they take into account body composition (Table 2, 3). In addition, "ideal" weight could also be used to determine target weight and energy requirements for cats under-going weight loss (Table 4).

The optimal body condition of 25% fat was determined by repeated imperial measurements and observation. The energy requirements per kg "ideal" weight were also determined by observation.

CLAIMS

1. A four legged domestic pet mammal body fat determining system for determining the percentage body fat of a four legged domestic pet mammal, comprising:

   - means for measuring a first body dimension having a high correlation with percentage body fat;
   - means for measuring a second body dimension having a low correlation with percentage body fat; and
   - a look-up table comprising a first storage area for storing therein entries of the first body dimension, a second storage area storing therein entries of the second body dimension and an output storage area storing an indication of the percentage body fat determined from a relationship between the first and second body measurements.

2. A system according to Claim 1, wherein the first body measurement is the circumference of the ribcage, taken at the 9th rib.

3. A system according to Claim 1 or Claim 2, wherein the second body measurement is a leg index measurement, which is the length of the hind limb measured between the patella (knee) and the calcaneal tuber (hock).

4. A system according to any preceding claim, wherein the output storage area provides an indication of whether the mammal is under, normal or overweight.

5. A system according to any preceding claim, wherein the output storage area provides a numerical percentage body fat.

6. A system according to any preceding claim, wherein the relationship between the percentage body fat and first and second body dimensions is given by the equation:-

$$PercentageBodyFat = [\frac{(\frac{R}{C_1} - L)}{C_2}] - L$$

where
R = ribcage circumference
L = leg index measurement
C1 = constant
C2 = constant

7. A system according to any preceding claim wherein the four legged mammal is a cat.

8. A lookup table for use in the system of any proceeding claim, comprising:

- a first storage area storing therein entries of the first body dimension;

- a second storage area storing therein entries of the second body dimension; and

- an output storage area storing an indication of percentage body fat determined from a relationship between the first and second body measurements.

9. A four legged domestic pet mammal target body weight determining system for determining a target body weight for a four legged mammal, comprising:

a system for measuring the percentage body fat of a four legged domestic pet mammal; and

a lookup table comprising a first storage area for storing entries of the percentage body fat, a second storage area for storing entries of body weight, and an output storage area storing an indication of the target body weight.

10. A system according to claim 9, wherein the relationship between the target weight and the percentage body fat is given by the equation:-

Target weight=1.33xBody weight(kg)x((100-% body fat)/100)

11. A system according to claim 9 or 10, wherein the target weight is an ideal weight.

12. A system according to claim 9, 10 or 11, wherein the system for measuring the percentage body fat is a system according to any of claims 1 to 7.

13. A system according to any of claims 9 to 12, further comprising an additional output storage area storing an indication of an energy allowance.

14. A system according to claim 13, wherein the indication of energy allowance is a daily allowance in kcal/kg.

15. A system according to any of claims 9 to 14, wherein the four legged mammal is a cat.

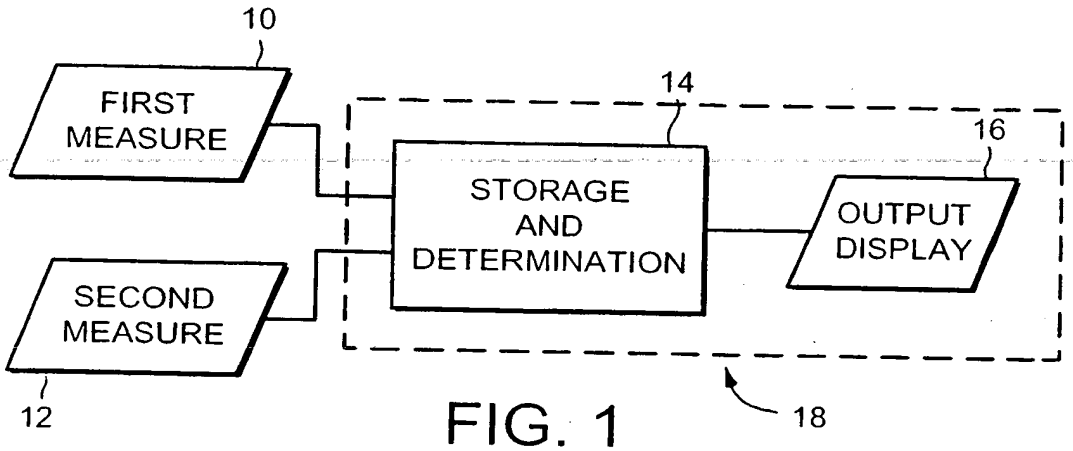


FIG. 1

BNSDOCID: <WO_____0028897A1_I_>

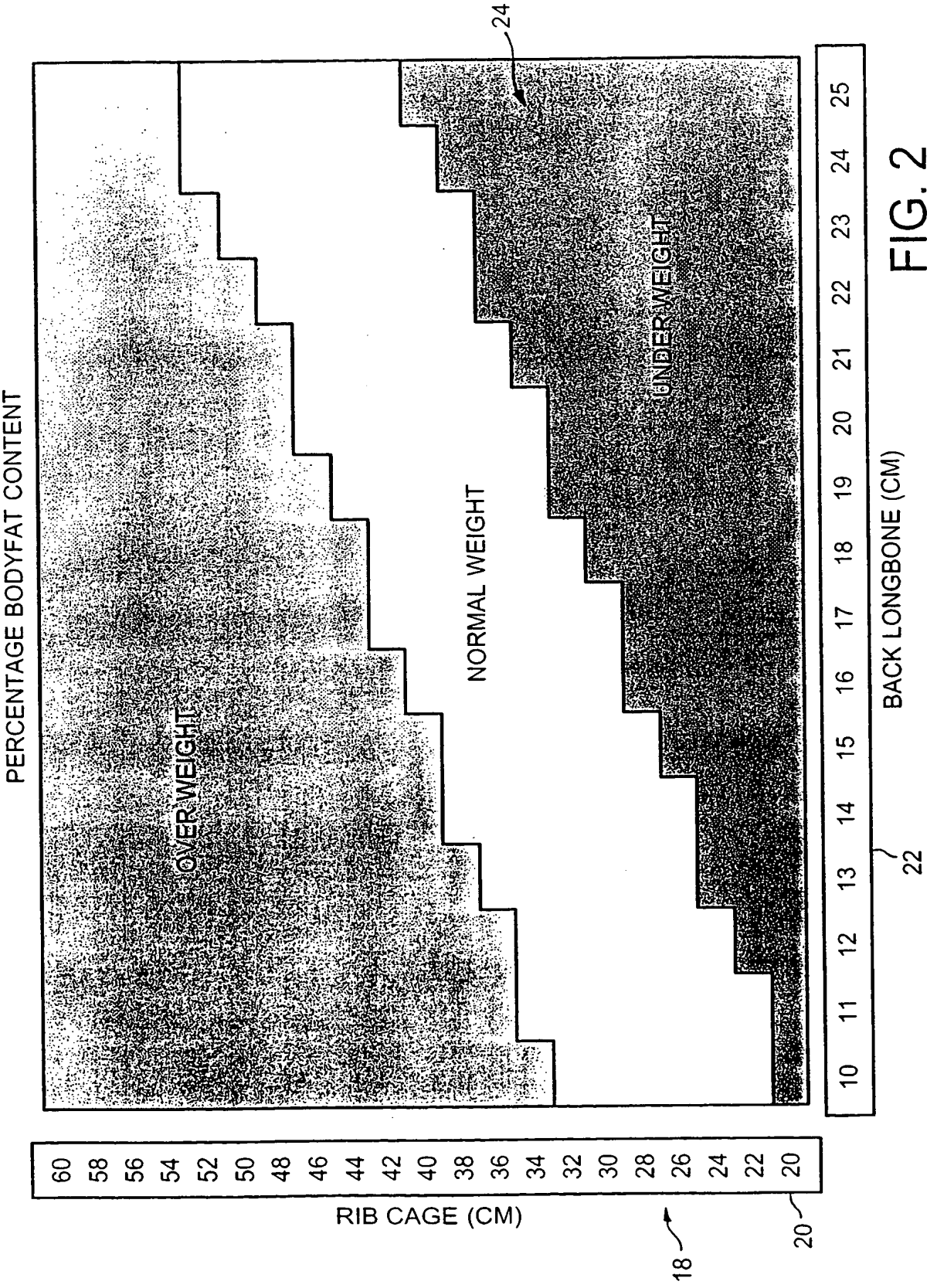


FIG. 2

BEST AVAILABLE COPY

BNSDOCID: <WO_____ 0028897A1_I_>

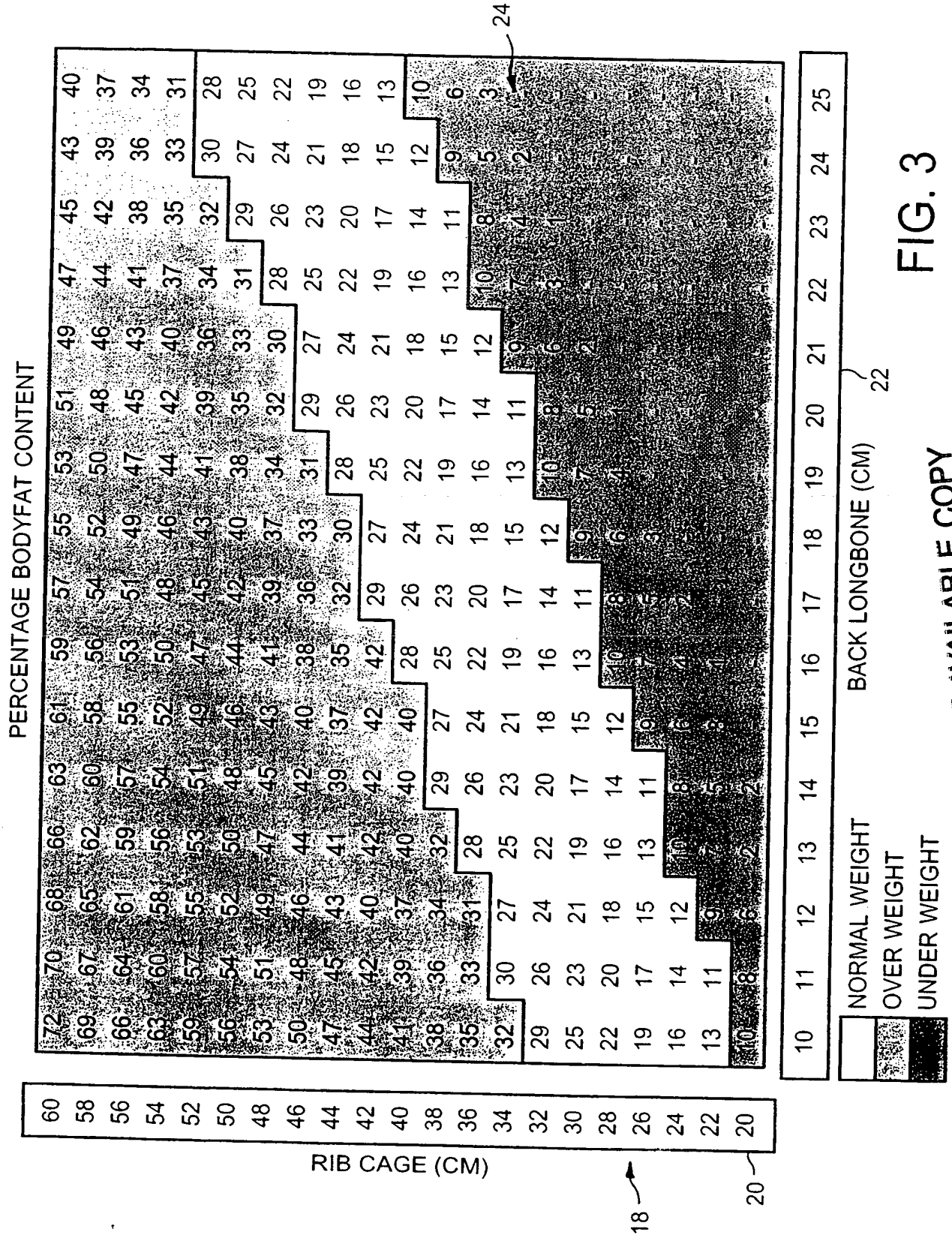


FIG. 3

BEST AVAILABLE COPY

BNSDOCID: <WO_____0028897A1_I_>

TABLE 1

'IDEAL' BODY WEIGHT (kg)

% FAT	BODY WEIGHT KG															
	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
10	3.6	4.2	4.8	5.4	6	6.6	7.2	7.8	8.4	9	9.6	10.2	10.8	11.4	12
15	3.4	4	4.5	5.1	5.7	6.2	6.8	7.3	7.9	8.5	9	9.6	10.2	10.7	11.3
20	3.2	3.7	4.3	4.8	5.3	5.9	6.4	6.9	7.4	8	8.5	9	9.6	10.1	10.6
25	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
30	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.1	6.5	7	7.4	7.9	8.4	8.8	9.3
35	2.6	3	3.5	3.9	4.3	4.8	5.2	5.6	6.1	6.5	6.9	7.3	7.8	8.2	8.6
40	2.4	2.8	3.2	3.6	4	4.4	4.8	5.2	5.6	6	6.4	6.8	7.2	7.6	8
45	2.2	2.6	2.9	3.3	3.7	4	4.4	4.8	5.1	5.5	5.9	6.2	6.6	6.9	7.3
50	2	2.3	2.7	3	3.3	3.7	4	4.3	4.7	5	5.3	5.7	6	6.3	6.6
55	1.8	2.1	2.4	2.7	3	3.3	3.6	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6
60	1.6	1.9	2.2	2.4	2.7	2.9	3.2	3.5	3.7	4	4.3	4.5	4.8	5.1	5.3

BEST AVAILABLE COPY

TABLE 2

DAILY ENERGY ALLOWANCE FOR A CAT WITH LOW ACTIVITY (50kcal/kg 'IDEAL' WEIGHT)

% FAT	BODY WEIGHT KG															
	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
10	251	293	335	377	419	461	503	545	587	628	670	712	754	796	838
15	237	277	317	356	396	435	475	514	554	594	633	673	712	752	791
20	223	261	298	335	372	410	447	484	521	559	596	633	670	708	745
25	209	244	279	314	349	384	419	454	489	524	559	594	628	663	698
30	196	228	261	293	326	358	391	424	456	489	521	554	587	619	652
35	182	212	242	272	303	333	363	393	424	454	484	514	545	575	605
40	168	196	223	251	279	307	335	363	391	419	447	475	503	531	559
45	154	179	205	230	256	282	307	333	358	384	410	435	461	486	512
50	140	163	186	209	233	256	279	303	326	349	372	396	419	442	465
55	126	147	168	189	209	230	251	272	293	314	335	356	377	398	419
60	112	130	149	168	186	205	223	242	261	279	298	317	335	354	372

TABLE 3

DAILY ENERGY ALLOWANCE FOR A CAT WITH NORMAL ACTIVITY (70kcal/kg 'IDEAL' WEIGHT)

	BODY WEIGHT KG															
% FAT	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
10	251	293	335	377	419	461	503	545	587	628	670	712	754	796	838
15	237	277	317	356	396	435	475	514	554	594	633	673	712	752	791
20	223	261	298	335	372	410	447	484	521	559	596	633	670	708	745
25	209	244	279	314	349	384	419	454	489	524	559	594	628	663	698
30	196	228	261	293	326	356	391	424	456	489	521	554	587	619	652
35	182	212	242	272	303	333	363	393	424	454	484	514	545	575	605
40	168	196	223	251	279	307	335	363	391	419	447	475	503	531	559
45	154	179	205	230	256	282	307	333	358	384	410	435	461	486	512
50	140	163	186	209	233	256	279	303	326	349	372	396	419	442	465
55	128	147	168	189	209	230	251	272	293	314	335	356	377	398	419
60	112	130	149	168	186	205	223	242	261	279	298	317	335	354	372

BEST AVAILABLE COPY

TABLE 4

DAILY ENERGY ALLOWANCE FOR WEIGHT LOSS (60% OF PREDICTED ER AT TARGET BODY WEIGHT, WHERE ER IS CONSIDERED TO BE 60kcal/kg IDEAL WT)

	BODY WEIGHT KG															
% FAT	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
10	129	151	172	194	215	237	259	280	302	323	345	366	388	409	431
15	122	142	163	183	203	224	244	265	285	305	326	346	366	387	407
20	115	134	153	172	192	211	230	249	268	287	306	326	345	364	383
25	108	126	144	162	180	198	215	233	251	269	287	305	323	341	359
30	101	117	134	151	168	184	201	218	235	251	268	285	302	318	335
35	93	109	124	140	156	171	187	202	218	233	249	265	280	296	311
40	86	101	115	129	144	158	172	187	201	215	230	244	259	273	287
45	79	92	105	119	132	145	158	171	184	198	211	224	237	250	263
50	72	84	96	108	120	132	144	156	168	180	192	203	215	227	239
55	65	75	86	97	108	119	129	140	151	162	172	183	194	205	215
60	57	67	77	86	96	105	115	124	134	144	153	163	172	182	192

INTERNATIONAL SEARCH REPORT

Inte :onal Application No
PCT/GB 99/03775

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B5/107 G01N33/12 G01G19/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B G01N G01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 98 08437 A (POWELL DAVID KEVIN) 5 March 1998 (1998-03-05) page 5, line 18 -page 8, column 32; figures	1,4,5 7

Y	PATENT ABSTRACTS OF JAPAN vol. 098, no. 012, 31 October 1998 (1998-10-31) & JP 10 192258 A (MATSUSHITA ELECTRIC WORKS LTD), 28 July 1998 (1998-07-28)	7
A	abstract	1

	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2000	18/04/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bosma, R

1

Form PCT/ISA/210 (second sheet) (July 1992)

BNSDOCID: <WO_____0028897A1_I. >

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 99/03775

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	RUSH E C ET AL: "Estimation of Body Fat in Caucasian and Polynesian Women from Anthropometric Measurements" APPLIED RADIATION AND ISOTOPES, vol. 49, no. 5-6, 6 May 1998 (1998-05-06), page 749-750 XP004110619 the whole document	1,7
X	FR 2 731 144 A (BERNARD GEORGES ET AL.) 6 September 1996 (1996-09-06) page 4, line 8 -page 6, line 29; figure 1	9,11, 13-15
A	US 5 372 141 A (GALLUP ET AL.) 13 December 1994 (1994-12-13) column 4 -column 17, line 41; figures	9-15

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. onal Application No
PCT/GB 99/03775

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9808437 A	05-03-1998	AU 3842997 A	19-03-1998
JP 10192258 A	28-07-1998	NONE	
FR 2731144 A	06-09-1996	NONE	
US 5372141 A	13-12-1994	NONE	

THIS PAGE BLANK (USPTO)

BNSDOCID: <WO_____0028897A1_I_>

THIS PAGE BLANK (USPTO)